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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/542,780

09/27/2005

Tetsuya Taki

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EXAMINER

GOODWIN, DAVID J

ART UNIT

PAPER NUMBER

2818

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/542,780	<b>Applicant(s)</b> TAKI, TETSUYA	
	<b>Examiner</b> David Goodwin	<b>Art Unit</b> 2818	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 09 October 2007.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1, 2, 3, and 6 are rejected under 35 U.S.C. 102(b) as being anticipated by Yamamoto (US 6,064,079).

3. Regarding claim 1.

4. Yamamoto teaches a group III nitride based semiconductor device (column 1 lines 45-60). Said device comprises a first p-layer (15, 16) and a second p-layer (16, 18) to each of which an acceptor impurity is added (column 5 lines 15-25). An intermediate layer (17, 34) is provided between and in contact with the first p layer and the second p layer (column 5 lines 25-40). The intermediate layer (17, 34) is doped with a donor impurity concentration (column 5 lines 25-55).

5. The concentration of donor impurity will inherently have a relation to the activation rates of the acceptor and donor impurities and also the temperature of the device. Let the donor impurity equal Y and the activation rate equal A and temperature equal T than there exists some equation wherein  $Y=f(A, T)$ . The applicant places no limitation on what f is. As this equation can be graphed there must be some relation.

6. Further, as there are acceptor present a carrier originating in the donor region will be compensated when it migrates into the acceptor region.

7. The limitation must distinguish from the prior art in terms of structure rather than function, *In re Schreiber*, 128 F.3d 1473, 1477-78, 44 USPQ2d 1429, 1431-32 (Fed. Cir. 1997); See also *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 228-29 (CCPA 1971). Claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function. *In re Danly*, 263 F. 2d 844, 847, 120 USPQ 528, 531 (CCPA 1959). "Apparatus claims cover what a device is, not what a device does." *Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F. 2d 1464, 1469, 15 USPQ2d 1525, 1528 (Fed. Cir. 1990).

8. Regarding claim 2.

9. Yamamoto teaches the donor impurity doped into the intermediate layer is doped with a concentration distribution corresponding to a concentration distribution of the acceptor impurity in the intermediate layer (fig 2B) (column 5 lines 35-60).

10. Regarding claim 3.

11. Yamamoto teaches the acceptor impurity is magnesium and the donor impurity is silicon (column 5 lines 10-45).

12. Regarding claim 6.

13. Yamamoto teaches the first p layer (15) includes a p cladding layer (15) made of p type AlGaN doped with Mg (column 5 lines 10-25). The second p-layer (18) includes a p contact layer (18) made of p type GaN doped with Mg (column 5 lines 10-30).

14.

***Claim Rejections - 35 USC § 103***

15. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

16. Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto (US 6,064,079) as applied to claim 1 above and further in view of Fukuda (JP2003-115610).

17. Regarding claim 4.

18. Yamamoto teaches elements of the claimed invention above in the rejection of claim 1.

19. Yamamoto does not teach the relative concentrations of the dopants.

20. Fukuda teaches a group III nitride semiconductor device. Said device comprises intermediate layers having concentration of Mg dopant of  $1\text{E}18/\text{cm}^3$  and intermediate layers having silicon dopant concentration of  $1\text{E}17/\text{cm}^3$  (translation paragraphs 0010-0015). The ration of which is 10 to 1.

21. It would have been obvious to one of ordinary skill in the art to dope the intermediate layer with these concentrations in order to reduce current leakage without affecting the crystal structure.

22. Regarding claim 5.

23. The above concentrations of dopants will result in a hole density of less than  $10^{17}/\text{cm}^3$ .

24.

25. Claims 7 through 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto (US 6,064,079) in view of Kaneyama (US 2002/0014632).

26.

27. Regarding claim 7.

28. Yamamoto teaches that a group III nitride semiconductor device is formed on a sapphire substrate (10) (column 5 lines 15-25). An n contact layer (12) formed on the sapphire substrate (10) (column 4 lines 30-40). An n cladding layer (13) formed on the n contact layer (12) (column 4 lines 30-45). A light emitting layer (14) formed on the n cladding layer (13) (column 4 lines 30-50). A p cladding layer (15, 16) and a p type contact layer (16, 18) to each of which an acceptor impurity is added (column 5 lines 15-45). An intermediate layer 17, 34) provided between the p cladding layer (15) and the p contact layer (18). A p electrode (22) is disposed on the p contact layer (18). An n electrode (21) disposed on the n contact layer (12). The intermediate layer (17, 34) is doped with a donor impurity concentration (column 5 lines 25-55).

29. The concentration of donor impurity will inherently have a relation to the activation rates of the acceptor and donor impurities and also the temperature of the device.

30. The limitation must distinguish from the prior art in terms of structure rather than function, *In re Schreiber*, 128 F.3d 1473, 1477-78, 44 USPQ2d 1429, 1431-32 (Fed. Cir. 1997); See also *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 228-29 (CCPA 1971). Claims directed to apparatus must be distinguished from the prior art in terms of

structure rather than function. *In re Danyl*, 263 F. 2d 844, 847, 120 USPQ 528, 531 (CCPA 1959). "Apparatus claims cover what a device is, not what a device does." *Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F. 2d 1464, 1469, 15 USPQ2d 1525, 1528 (Fed. Cir. 1990).

31. Yamamoto does not teach that the p electrode comprises a thin film electrode and a thick film electrode.

32. Kaneyama teaches group III nitride semiconductor device comprises a contact layer (109). A thin film electrode (110) is disposed on said contact layer (109). A thick film electrode (120) is disposed on the thin film electrode (109) (fig 1) (paragraph 0036-0039).

33. It would have been obvious to one of ordinary skill in the art to form an electrode of a thin film and a thick film in order to form a good electrical connection without blocking the emitted light.

34. Regarding claim 8.

35. Yamamoto teaches that the light emitting includes a multiquantum well structure (14) formed on the n cladding layer (13) by laminating multiple pairs of well layers of undoped InGaN and barrier layer of undoped GaN (column 4 lines 25-45).

36. Regarding claim 9.

37. Kaneyama teaches group III nitride semiconductor device comprises a contact layer (109). A thin film electrode (110) is disposed on said contact layer (109). Said thin film electrode (110) is formed of a layer of cobalt (111) and a second layer of gold (112) (paragraph 0038). A thick film p electrode (120) is disposed on the thin film

electrode (109) (fig 1) (paragraph 0036-0039). Said thick film p electrode is formed by laminating a first layer of vanadium (121), a second layer of gold (122), and a third layer aluminum (123) sequence on the thin film p electrode (110) (paragraph 0039).

38. It would have been obvious to one of ordinary skill in the art to form an electrode of a thin film and a thick film in order to form a good electrical connection without blocking the emitted light.

39. Regarding claim 10.

40. Kaneyama teaches a reflective metal layer (150) of aluminum formed on the sapphire substrate (101) (paragraph 0040).

41. It would have been obvious to one of ordinary skill in the art to form a reflective metal layer in order to direct all emitted light in one direction thereby increasing the efficiency of the device.

42. Claims 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto (US 6,064,079) as applied to claim 1 above and further in view of Fukuda (JP2003-115610).

43. Regarding claim 11.

44. Yamamoto teaches elements of the claimed invention above in the rejection of claim 1.

45. Yamamoto further teaches that the intermediate layer (17, 34) has a high resistivity.

46. Yamamoto does not teach the relative concentrations of the dopants.



47. Fukuda teaches a group III nitride semiconductor device. Said device comprises intermediate layers having concentration of Mg dopant of  $1\text{E}18/\text{cm}^3$  and intermediate layers having silicon dopant concentration of  $1\text{E}17/\text{cm}^3$  (translation paragraphs 0010-0015). The ration of which is 10 to 1.

48. Further, an amount of donor impurity will inherently offset an amount of acceptor impurity.

49. It would have been obvious to one of ordinary skill in the art to dope the intermediate layer with these concentrations in order to reduce current leakage without affecting the crystal structure.

50. The limitation must distinguish from the prior art in terms of structure rather than function, *In re Schreiber*, 128 F.3d 1473, 1477-78, 44 USPQ2d 1429, 1431-32 (Fed. Cir. 1997); See also *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 228-29 (CCPA 1971). Claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function. *In re Danyl*, 263 F. 2d 844, 847, 120 USPQ 528, 531 (CCPA 1959). "Apparatus claims cover what a device is, not what a device does." *Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F. 2d 1464, 1469, 15 USPQ2d 1525, 1528 (Fed. Cir. 1990).

51. Regarding claim 12.

52. Fukuda teaches that the intermediate layer (11) is about 100 nm (table 1).

53. It would have been obvious to one of ordinary skill in the art to form an intermediate layer of about 100 nm in order to sufficient charge blocking to prevent current flow.

54. Regarding claim 13.

55. Yamamoto does not teach the relative concentrations of the dopants.

56. Fukuda teaches a group III nitride semiconductor device. Said device comprises intermediate layers having concentration of Mg dopant of  $1\text{E}18/\text{cm}^3$  and intermediate layers having silicon dopant concentration of  $1\text{E}17/\text{cm}^3$  (translation paragraphs 0010-0015). The ration of which is 10 to 1.

57. It would have been obvious to one of ordinary skill in the art to dope the intermediate layer with these concentrations in order to reduce current leakage without affecting the crystal structure.

58. Regarding claim 14.

59. Fukuda teaches a group III nitride semiconductor device. Said device comprises intermediate layers having concentration of Mg dopant of  $1\text{E}18/\text{cm}^3$  and intermediate layers having silicon dopant concentration of  $1\text{E}17/\text{cm}^3$  (translation paragraphs 0010-0015). This results in the donor and acceptor activation rates being substantially equal.

60. It would have been obvious to one of ordinary skill in the art to dope the intermediate layer with these concentrations in order to reduce current leakage without affecting the crystal structure.

61. Claims 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto (US 6,064,079) as applied to claim 1 above and further in view of Nomura (US 2003/0147440).

62. Regarding claim 15.

63. Yamaoto teaches elements of the claimed invention above.

64. Yamaoto does not teach the composition of the AlGa<sub>N</sub> cladding layer.
65. Nomura teaches an AlGa<sub>N</sub> cladding layer comprised of Al<sub>0.15</sub>Ga<sub>0.85</sub>N (paragraph 0062).
66. It would have been obvious to one of ordinary skill in the art to use a cladding layer of Al<sub>0.15</sub>Ga<sub>0.85</sub>N in order to have the proper bandgap for generating light.
67. Claims 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto (US 6,064,079) as applied to claim 1 above and further in view of Ishikawa (US 4,987,096).
68. Regarding claim 16.
69. Yamaoto teaches elements of the claimed invention above.
70. Yamaoto does not teach the concentration of dopant in the current blocking layer.
71. Ishikawa teaches a current blocking layer having a silicon dopant concentration of  $2 \times 10^{18} \text{ cm}^{-3}$ .
72. It would have been obvious to one of ordinary skill in the art to dope to a concentration of  $2 \times 10^{18} \text{ cm}^{-3}$  in order to provide enough donors to block the acceptor charge carriers.
- 73.

***Response to Arguments***

74. Applicant's arguments filed 10/09/07 have been fully considered but they are not persuasive.

75. The applicant argues that layers 15 and 17 do not contact the intermediate layer (17). The applicant further notes that p-type layers (16) contact the intermediate layer (17).

76. The examiner appreciates that the applicant recognizes that first p-layer (15, 16) and a second p-layer (16, 18) contact the intermediate layer (17, 34) as illustrated in Yamamote fig 2A.

77. The applicant argues that Yamamote does not teach that the intermediate layer is doped with a donor impurity. The applicant argues that Yamamote does not disclose that layer 17 is doped with silicon and Yamamoto only teaches that layer 34 is doped with silicon.

78. The examiner appreciates that the applicant recognizes that layer 34 is doped with silicon. The applicant will further recognize that layer 34 comprises a portion of the intermediate layer (17, 34), Therefore Yamamoto teaches that the intermediate layer (17, 34) is doped with silicon.

79. The applicant argues that Yamamoto does not teach that layer 34 is doped at a concentration distribution that is based on the activation rates of the acceptor and donor impurities.

80. The applicant will note that the concentration of donor impurity will inherently have a relation to the activation rates of the acceptor and donor impurities and also the temperature of the device. Let the donor impurity equal  $Y$  and the activation rate equal  $A$  and temperature equal  $T$  than there exists some equation wherein  $Y=f(A, T)$ . The

applicant places no limitation on what  $f$  is. As this equation can be graphed there must be some relation.

81. Unless the applicant specifies what the relationship is than any relationship will satisfy the claim.

82. The applicant argues that layer 34 does not contact the intermediate layer at a surface.

83. The applicant will note in figure 2A of Yamamoto that at the interface of layer 34 and layers 16 that layer 34 contacts layers 15 at a surface.

84. The applicant argues that Yamamoto does not teach that the distribution of the activation rates and so that a compensation will occur to reduce carrier concentration in the intermediate layer.

85. As noted above the distribution of the impurities in the intermediate layer can be described as a function of the activation rates. Further at a temperature at which the impurities in the intermediate layer are active carriers from the oppositely doped first and second layers that enter the intermediate layer will be compensated. This is a result of the intermediate layer have an opposite conductivity type from that of the first and second layers.

86. The operation of this compensation is functional language whereas the structural capacity to perform this function is present in Yamamoto.

### ***Conclusion***

87. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David Goodwin whose telephone number is (571)272-8451. The examiner can normally be reached on Monday through Friday, 9:00am through 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Loke can be reached on (571)272-1657. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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DJG

STEVEN LOKE  
SUPERVISORY PATENT EXAMINER

A handwritten signature in black ink, appearing to read "Steven Loke", is written below the printed name and title.